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Intelligence Analysis: Once Again

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14. ABSTRACT

This paper provides a sense of the literature written specifically about *intelligence analysis*, including general definitions, themes, divergent views, and observations on gaps in literature coverage. A comprehensive review of the literature indicates that while much has been written, largely there has not been a progression of thinking relative to the core aspect and complexities of doing intelligence analysis; hence, the title, "Once Again," with all its connotations. The essay focuses on the core aspect of analysis, the determination of meaning. After a brief review of Sherman Kent's comprehensive work, the role of mental models in determining meaning is discussed, followed by recurring alternative views of analysis processes and their chronologies. Key elements of the analysis processes are then discussed, including hypotheses, information research, and the marshalling of evidence, including how they influence the determination of meaning. The literature on rigor in intelligence analysis is reviewed, including the role of structured analytic techniques and automated tools. The paper concludes with observations on the state of the literature.

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Introduction

This essay provides a sense of the literature written specifically about *intelligence analysis*, including general definitions, themes, divergent views, and observations on gaps in literature coverage. A comprehensive review of the literature indicates that while much has been written, largely there has not been a progression of thinking relative to the core aspect and complexities of doing intelligence analysis; hence, the title, "Once Again," with all its connotations. The essay focuses on the core aspect of analysis, the determination of meaning. After a brief review of Sherman Kent's comprehensive work, the role of mental models in determining meaning is discussed, followed by recurring alternative views of analysis processes and their chronologies. Key elements of the analysis processes are then discussed, including hypotheses, information research, and the marshalling of evidence, including how they influence the determination of meaning. The literature on rigor in intelligence analysis is reviewed, including the role of structured analytic techniques and automated tools. The essay concludes with observations on the state of the literature.

Hundreds of works have been written on intelligence. Many of these works at least touch on the subject of intelligence *analysis*. However, while still a large body of work, it is a considerably smaller set that specifically addresses the core aspect of intelligence analysis. By necessity, the literature represented in this essay is a much smaller set than that reviewed in its preparation. Consequently, the same can be said of this essay as Platt (1957, p. xvii) indicated about his classic book on strategic intelligence, quoting Vannevar Bush, "Everything I say would be contested in some quarters."

Background

What is intelligence analysis? The lack of an agreed upon definition is hardly surprising given the lack of agreement on the term intelligence. The recent efforts of Warner (2002) and Johnston (2005, p. 4) to establish a definition of intelligence are part of a never ending effort. Many of the definitions of intelligence encompass specific aspects of intelligence analysis. Intelligence analysis has been described in terms of the sources and classifications of information, processes, purposes, individual and organizational efforts, and consumers. Common themes include the use of single or all sources of information, use of denied or secret information (although most find this too limiting), discerning pertinent information, making inferences and judgments, developing knowledge individually and collectively of current and potential threats to national security, and providing useable and actionable information for the military and government and non-government policymakers. Most descriptions of the functions and purpose of intelligence analysis also contain elements that are consistent with the standard definitions of both analysis and synthesis (e.g., Webster's New World Dictionary, Third College Edition):

"Analysis: a separating or breaking up of any whole into its parts, esp. with an examination of these parts to find out their nature, proportion, function, interrelationship, etc."

"Synthesis: the putting together of parts or elements so as to form a whole"

With these definitions neither the source of the information nor the purpose of the analysis or synthesis defines or limits the scope of intelligence analysis. The simplistic definition then is that intelligence analysis is analysis done by intelligence organizations.

Understanding, knowledge, and the need to determine meaning from information are inherent in the preceding definitions. Indeed the essence of intelligence analysis is determining the meaning of information to develop knowledge and understanding. Many authors have rightly pointed out that this aspect of analysis takes place in broader organizational and social contexts. The importance of viewing analysis holistically in these contexts as work done by individuals and groups with all of their respective attributes cannot be understated. Other Compendium essays cover many of these aspects.

The meaning derived from the analysis is used to address many different types of questions, which are categorized in variety of ways. A general classification of the questions, sometimes described as types of intelligence or analysis, includes: strategic; tactical or combat; current; and indications and warning. These classifications, with various excursions in terminology, have been relatively stable over time. Analysis may also be based on a single source, a combination of several sources, or consideration of all sources of information. One might expect the literature would discuss the processes and attributes associated with the various types of analysis. Generally, this is not the case. The intelligence literature, with few exceptions, suggests that processes, procedures, and cognitive attributes of analysis are the same

for all types of analysis. Certainly, some commonality exists among the different types of analysis, but the major difference is the complexity of the analysis.

In the late 1940s, the term strategic intelligence entered the active discourse. Kent (1949, p. xi) acknowledges Pettee's (1946) book as a trail breaker in the literature of strategic intelligence. Both Kent (1949) and Platt (1957) highlight the challenging character of strategic intelligence: it is vital for national survival; draws important conclusions from inadequate premises; concerns the future and its possibilities and probabilities; addresses the problems of estimating what other human beings can and will do across a broad band of the future; encompasses a large and diverse substantive content, thus requiring group effort; necessitates the use of specialized techniques, considerably extending the expertise needed; and is done on a comprehensive scale, "the world is literally its province." (Platt 1957, p. 16) All of these characteristics increase the complexity of the work. While other types of analysis share some of these characteristics, strategic intelligence analysis encompasses all the cognitive and information complexities associated with analysis. Thus, to represent the full complexities of analysis, this representation of the literature concentrates on analysis to fulfill the need for strategic intelligence.

In the Beginning…..Sherman Kent

Sherman Kent's 1949 book, *Strategic Intelligence for American World Policy*, is the seminal publication for describing and explaining the processes and attributes of strategic intelligence. Many consider it the foundation for all subsequent research and publications on intelligence analysis. This is best illustrated by Professor Ernest May, a leading authority on the history of intelligence, in his 1989 remarks. When asked why he continued to quote from Kent's book written 40 years earlier, despite the numerous books published since, Professor May replied,

"Yes, but with concept after concept, in 40 years nobody has ever stated things as smartly as Kent." (Davis 2002, p. 7)

Kent deals with nearly all aspects of intelligence. He begins "Intelligence is Knowledge." (Kent 1949, p.1) To set the stage for his discussion of the analysis process, he indicates:

> "…intelligence activity consists basically of two sorts of operation…the *surveillance operation,* by which I mean the many ways by which the contemporary world is put under close and systematic observation, and the *research operation.* By the latter I mean the attempts to **establish meaningful patterns** out of what was observed in past and attempts **to get meaning** out of what appears to be going on now. The two operations are virtually inseparable…" (Kent 1949, p. 4) **(emphasis added)**
>
> "…research is a systematic endeavor **to get firm meaning** out of impressions…Research is the only process which we of the liberal tradition are willing to admit is capable of giving us the truth, or a closer approximation to truth…truth is to be approached, if not attained, through research guided by systematic method. In the social sciences which very largely constitute the subject matter of strategic intelligence, there is such a method. It is much like the method of physical sciences. It is not the same method, but it is a method none the less." (Kent 1949, pp. 155-156) **(emphasis added)**

Kent (1949) identified three classes of substantive content: *descriptive, current reportorial,* and *speculative-evaluative.* He describes the *descriptive* as "…basic to the other two…the groundwork which gives meaning to day-to-day change and…without which speculation into the future is likely to be meaningless." (Kent 1949, p. 11) *Current reportorial* is described as "Keeping track of the modalities of change…" (Kent 1949, p. 30) Knowledge

which is "…far more speculative than…the basic descriptive and current reportorial…" and "…puts a very high premium on the seeker's power of evaluation and reasoned extrapolation…" is called *speculative-evaluative.* (Kent 1949, pp. 39-40)

Like few others, Kent (1949) covers the spectrum of issues associated with analysis in a comprehensive, holistic way. He addresses intelligence as both organization and activity. While beyond the scope of this essay, his concerns about intelligence producer and consumer relationships and issues of integrity and objectivity have been discussed extensively in the literature. Kent's thoughts about analysts' views impacting the analysis, analytic processes, and the effects of short-term consumer questions on long-term research are especially relevant to this essay. Later sections discuss these topics and examine them along with the subsequent literature on intelligence analysis, beginning with the role of what Kent (1949, p. 199) referred to as "patterns of thought."

Mental Models and Determining Meaning

The intelligence literature has long reflected an appreciation that determining meaning is influenced by the analyst's mindset, mental model, or frame of mind. Kent (1949, p. 199) indicated "…an intelligence staff which must strive for reasoned and impartial analysis…has its own difficulties with view, position, slant, and line…it is made up of men whose patterns of thought are likely to color their hypotheses and whose colored hypotheses are likely to make one conclusion more attractive than the evidence warrants."

Heuer (1999, p. 10), among others, has also written extensively about the relationship between an analyst's mindset and his or her interpretation of information, indicating that a mindset is a screen or lens through which one perceives the world. Davis' (1992, p.13) characterization of mindset as the "…distillation of the intelligence analyst's cumulative factual

and conceptual knowledge into a framework for making estimative judgments on a complex subject" is the tenor of the literature. However, while there is a general appreciation of the role of mindset, all the various factors that form and change one's mindset (mental model) are less well represented in the intelligence literature.

Context is one of the factors that forms and changes mental models. "It is the context of the situation alone which gives point and meaning to the subsequent elements of the speculation," writes Kent (1949, p. 45). Similarly Heuer (1999, p. 41) writes, "The significance of information is always a joint function of the nature of the information and the context in which it is interpreted. The context is provided by the analyst in the form of a set of assumptions and expectations concerning human and organizational behavior."

More recently, Patterson, Roth, and Woods (Patterson et al. 1999 & 2001) have written extensively on the importance of context relative to the problem being solved, specifically as it relates to intelligence analysts determining meaning. In a more recent work Woods et al. (2002, p. 27), state, "…the significance of a piece of data depends on: other related data; how the set of related data can vary with larger context; the goals and expectations of the observer; the state of problem-solving process and stance of others." Importantly, this statement highlights the role of purpose (the problem to be solved) in the determination of meaning.

In addition to the role of context and purpose in shaping the mental model, other factors are recognized such as past experience, education, cultural values, role requirements, organizational norms and the specifics of the information received (Heuer 1999, p. xxi). Given the importance of the mental model in influencing and shaping the analysis (i.e., from problem exploration and formulation, to purpose refinement, through data acquisition and evaluation, and

ultimately determining meaning and making judgments), it is not surprising how it influences the discussion of intelligence analysis.

Many criticisms of intelligence analysis, including those in retrospective studies of intelligence failures, center on the negative aspects of mindset or analysts' use of mental models. These criticisms include the lack of "objectivity" in interpretation, the prevalence of many forms of bias as explicated in the scientific literature and in Heuer's work (1999, pp. 111-171), and the lack of rigor. The presence of inappropriate collective mental models is also central to the concerns expressed about groupthink.

Based on these concerns and criticisms, many techniques for various stages of the intelligence process have been recommended to improve intelligence analysis; however, evaluation is needed. Such techniques include devil's advocacy, red teaming, linchpin analysis, various modeling techniques, and collaborative approaches such as wikis and blogs, etc. ('Improving Intelligence Analysis' 2007, p. 31). Yet, the scientific literature suggests much more complexity is involved in ameliorating potentially negative effects of mental models than merely application of a specific technique, which may have limited efficacy outside the boundaries and conditions under which empirical studies were done.

Mental models also have positive effects since they are based on past experience, education, and expertise, resulting in a larger repertoire of reasoning strategies ('Improving Intelligence Analysis' 2007, p. 46). The advantages of having well-formed, expansive mental models, however, are rarely mentioned in the intelligence literature.

Although recommended by Heuer (1999, p. 178), there has been little systematic research on the application of these and other techniques to intelligence analysis based on the extensive scientific findings, and few scientific studies have been focused specifically on intelligence

analysis. Given the role of mental models in determining meaning, the lack of treatment in the intelligence literature is a significant gap. Research is needed to apply the diverse and systematic research of cognitive psychology and other fields on how mental models are formed and changed; and to understand the components of mental models, how to leverage the positive effects of mental models, and how to avoid pitfalls and ameliorate the negative effects on intelligence analysis.

Data-Driven Analysis, Conceptually-Driven Analysis, and the Mosaic Theory of Analysis

The nature and role of the mental model is central to Heuer's (1999, p. 59-62) descriptions of "Data-Driven Analysis," "Conceptually (sic) Driven Analysis," and the mosaic or jigsaw puzzle analogy, which Heuer calls the "Mosaic Theory of Analysis." These terms, first published in 1979, are frequently mentioned in the literature.

Data-Driven and Conceptually-Driven Analysis

Heuer refers to these as "types of analysis." Other authors have not elaborated on descriptions of Data-Driven and Conceptually-Driven Analysis. However, at times both are referred to as descriptions of the analysis process, with subsequent authors equating Data-Driven to bottom-up or evidence-based processes and Conceptually-Driven to top-down or hypotheses-driven processes, which are discussed later in this essay. However, *Heuer's main points are not in terms of the analysis process,* but focus on the nature and complexity of the problem (purpose), the development of the mental model, and the role that mental model plays.

In Heuer's (1999, p. 59) description of Data-Driven Analysis, it is used for analyzing subjects where rules and procedures are relatively well established, most elements of the mental model can be made explicit, there is agreement on the appropriate model, and there are relatively objective standards for judging the quality of analysis. "In this type of analysis, accuracy

depends primarily upon the accuracy and completeness of the available data." In other words, its use is appropriate for subjects that are relatively well understood. The description does not indicate the sequence or process of analysis.

In contrast, "…at the opposite end of the spectrum from data-driven analysis…," is Conceptually-Driven Analysis (Heuer 1999, pp. 59-60). It is used for questions that do not have neat boundaries, when there are many unknowns, many potentially relevant variables, imperfectly understood relationships with enormous complexity and uncertainty, little tested theory, no agreed upon analytical schema, and largely implicit mental models. "Other analysts examining the same data may well reach different conclusions, or reach the same conclusions but for different reasons. This analysis is conceptually driven, because the outcome depends at least as much upon the conceptual framework employed to analyze the data as it does upon the data itself."

Mosaic or Jigsaw Puzzle Analogy

The nature and role of the mental model are also dominant in the discussions about the utility of a mosaic or jigsaw puzzle analogy. It is a frequently used and debated analogy of the analysis process. The assumption about whether or not the analyst's mental model plays a role is the focus of the debate.

The use of the terms, jigsaw puzzle and mosaic, are credited as originating with early Directors of the Central Intelligence Agency (CIA) (Hilsman 1952, p. 3). Rear Admiral Roscoe H. Hillenkoetter (1948, p. 5), who assumed his duties as CIA Director in 1947, described the intelligence product as a "…giant jig-saw puzzle, into which we are continually trying to fit the pieces." While he did not mention the term "mosaic," Lt. Gen. Hoyt S. Vandenberg (1947, p.

498), in his testimony to the Senate as CIA Director, described intelligence in terms of completing a "picture."

Hilsman (1952, p. 4) implies criticism of Vandenburg, stating that "Apparently he believes that what information is relevant and necessary is determined only by the facts themselves." Hilsman indicates the implication of the picture-puzzle analogy is that the process of analysis is "…a question merely of assembling facts in much the same common-sense way that one puts together a broken vase: by looking at the pieces and seeing how they fit." He (Hilsman 1952, p. 15) goes on to say that "Facts cannot in themselves contain self-evident or obvious answers," rejecting the analogy and implying that Hilsman does not consider that the puzzle is viewed with the benefit of a mental model.

Like Hilsman (1952), Heuer also rejects the jigsaw puzzle analogy, stating it has distorted understanding of the analytic process (Heuer 1999, p. 61). Heuer's rejection is most frequently cited by others who oppose this analogy. He describes the mosaic theory as "…small pieces of information are collected that, when put together like a mosaic or jigsaw puzzle, eventually enable analysts to perceive a clear picture of reality. The analogy suggests that accurate estimates depend primarily upon having all the pieces, that is, upon accurate and relatively complete information." Heuer (1999, p. 62) also indicates that "Accurate estimates depend at least as much upon the mental model used in forming the picture as upon the number of pieces of the puzzle that have been collected." Heuer's distinction between mosaic analysis and both data-driven and conceptually-driven analysis underscores his view that mental models are not used in the mosaic approach.

Despite these criticisms, others find it a useful analogy, as a puzzle with missing pieces and other variations. For example, another director of CIA, William E. Colby (Hirschfeld 1987,

pp. 37-38), said "The intelligence analysis process is like a jigsaw puzzle; one puts all the little pieces together…you see the picture and overall design long before you have filled in the last puzzle piece…The excellent work of our analysts…consists of putting these pieces together. They come up with very good overall designs of the scene without necessarily every last item." Colby's view contrasts with Heuer's that all the pieces are needed.

Recently Boslough (2005, p. 1), discussed the puzzle analogy as useful but neglecting "…that the problem is both distributed and dynamic." Most recently, Johnson (2007, p. 2) asserted it is "A useful metaphor for thinking about strategic intelligence..."

Despite the prolonged use of the jigsaw puzzle analogy, there is only one description in the intelligence literature of the cognitive processes associated with it (Thompson et al. 1984, p. 4-2). It emphasizes the roles of context and mental models:

> "If the picture of the completed puzzle is provided then a schema already exists to direct the search for particular pieces…successful completion…merely requires the matching of individual pieces with parts of the given picture**.** If no picture is provided, the puzzle is more difficult…One must examine a piece or group of pieces for *context* clues so that an initial conceptual model can be developed. This model then directs the search for particular pieces, some of which might lead to the rejection of the initial model and the development of another one, in a feedback loop."

Notably this description is suggestive of much later descriptions about the analysis process as "sensemaking" discussed later in this essay. These emphasize the mutual, iterative relationship between the frame (the puzzle picture if provided or the concept of the picture that must be developed) and the data (the pieces of the puzzle), as well as how the model (frame)

"directs the search for particular pieces" (the data). Boslough's (2005, p. 1) description also captures the dynamic, evolving nature of analysis of the sensemaking descriptions.

Even though the jigsaw puzzle analogy has been rejected by many, there is a common belief in the intelligence literature that mental models are used and that the facts do not speak for themselves. There is also a common belief that analysts must extract meaningful patterns from the data available (Knorr 1964, p. 23; Clarkson 1981, p. 9). Given the benefit of a mental model, it is not evident how extracting meaningful patterns to form a picture is cognitively or conceptually different than forming a picture from puzzle pieces.

Analysis Processes

Analysis and Scientific Methods

Using scientific methods in intelligence analysis and discussing the analytic process in terms of scientific methods is a frequent, recurring theme in the intelligence literature. The belief that using "the scientific method is the only way of knowing that consistently produces reliable knowledge" motivates its application to analysis (Bruce 2005, p. 4). However, there is no consistent definition of the scientific method in the literature. For some, the logical reasoning underlying the scientific method is based on the principle of eliminating hypotheses (Heuer 1981, p. 76). For others (Collier 2005, p. 19), the steps in the scientific method are:

1. Develop research problem or question.
2. Review existing knowledge.
3. Develop theoretical framework (model).
4. Develop research hypotheses.
5. Conduct research design.
6. Conduct data collection.

7. Conduct data analysis.

8. Distribute new knowledge.

Another definition of the scientific method is "the formulation of hypotheses, collection of relevant data, testing and evaluation of hypotheses, and the logical derivation of conclusions." (Moore 2006, p. 63)

Analysis Processes

Frequently Sherman Kent is acknowledged as the individual who first proposed modeling the analysis process based on the scientific method, especially the method used in the social sciences. As referenced earlier, Kent instead proposed another method "specifically designed" for intelligence, choosing not to modify the methods of the social or physical sciences. The essence of Kent's method is *exploration of the intelligence problem, data collection prior to deliberate hypotheses generation,* data evaluation, more data collection, followed by hypotheses generation. Kent describes seven steps or stages (Kent 1949, pp. 157-158):

"1. The appearance of a problem requiring the attention of a strategic intelligence staff.

2. Analysis of this problem to discover which facets of it are of actual importance to the U.S. and which of several lines of approach are most likely to be useful to its governmental customers.

3. Collection of data bearing upon the problem as formulated in stage 2. This involves a survey of data already at hand and available in the libraries of documentary materials, and an endeavor to procure new data to fill in gaps.

4. Critical evaluation of the data thus assembled.

5. Study of the evaluated data with the intent of finding some inherent meaning. The moment of the discovery of such a meaning can be called the moment of hypotheses. In reality there *is rarely such a thing as one moment of hypothesis* though some students of method, largely as a convenience, speak as if there were. *Nor can it be said categorically at what stage in the process hypotheses appear*. One would be pleased to think that they appeared at this, the respectable stage 5, but in actual practice they begin appearing when the first datum is collected. They have been known to appear even before that, and they may continue to appear until the project is closed out—or even after that. (*emphasis added)*

6. More collecting of data along the lines indicated by the more promising hypotheses, to confirm or deny them.

7. Establishment of one or more hypotheses as truer than others and statement of these hypotheses as the best present approximation of truth." This stage is often referred to as the presentation state *[sic]*."

Kent's description in Stage 5 about the nature of hypotheses provides key insights on his thinking about *the dynamic nature of determining meaning*. It indicates that meaning associated with the problem at hand is resident at the start of the project, determined during problem exploration, forms and changes continuously as each piece of data is reviewed, evolves during the development and crystallization of various hypotheses, and continues to be adjusted even after the project is done.

In his description of the analysis process, Platt (1957, p. 76) has two criticisms of the many renditions of the scientific method. First, they do not start with a general survey and plan

of the whole problem and, second, they lead one to believe that it is "…a streamlined succession of one logical step after another…," rather than a highly iterative process with many forward and feedback loops. Platt (1957, p. 82) also emphasizes "…that each step when taken is considered as *tentative.*" Because new knowledge changes one's interpretation of the information and increases understanding of the issues, what is done at each step is changeable. Platt's (1957, pp. 77-82) seven steps are much like Kent's, with *both emphasizing up front problem exploration (enabling purpose refinement) and data collection prior to deliberate hypotheses generation,* as well as the iterative or tentative nature as one goes through the process of determining meaning.

Numerous other brief descriptions of the analysis process also appeared between 1976 and 1991 *stating data collection or information acquisition occurs before hypotheses generation* (e.g., Clauser & Weir 1976, p. 77; Phelps et al. 1984, p. 2; Palmer 1991, p. 35). A detailed description of the analysis process equivalent to Kent's and Platt's then appeared in 2005 (RAND 2005, p. 2).

Subsequently in 2006, another model (Figure 1) of the intelligence analysis process consistent with Kent's and Platt's was published, especially when taking into consideration the narratives describing their seven stages or steps. This model was derived from the results of a cognitive task analysis of intelligence analysts (Pirolli 2006, p.2; Pirolli & Card 2006, p. 3). The overall process represented in the model is described as "A Notional Model of Analyst Sensemaking," with the cognitive task analysis indicating that the bottom-up and top-down processes shown in each loop are "…invoked in an opportunistic mix." (Pirolli & Card 2006, p. 1-4).

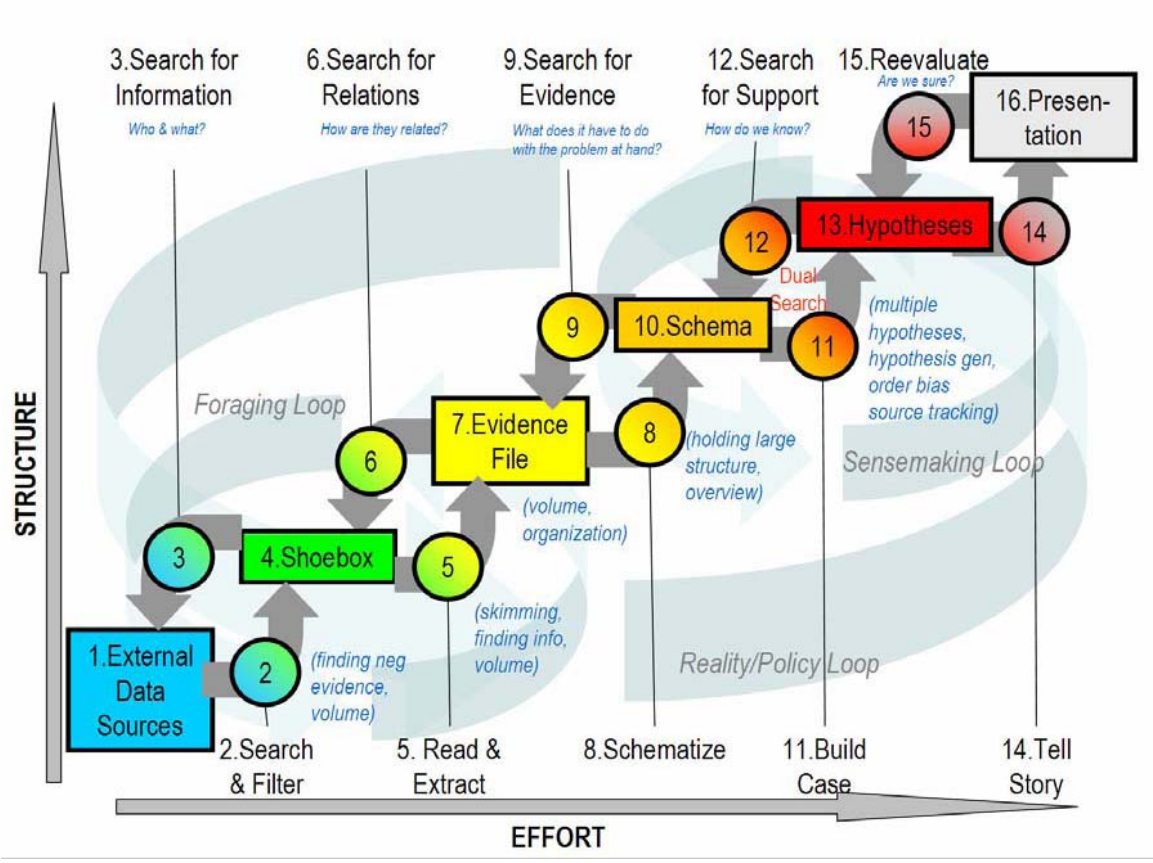

Figure 1. Notional Model of Analyst Sensemaking

The term "sensemaking" emerged in the intelligence literature predominantly in the last five years as a term used to describe the analysis process (e.g., Fishbein & Treverton 2004; Cooper 2005). Most often the intelligence literature references the research of Gary Klein and Karl E. Weick. In a recent paper, Klein et al. (2007, p. 114) defines sensemaking "…as the deliberate effort to understand events," describing the elements of sensemaking using the terms "data" and "frame." A frame is "…an explanatory structure that defines entities by describing their relationship to other entities." Klein et al. (2007, p. 118) go on to say that "The data identify the relevant frame, and the frame determines which data are noticed. Neither of these comes first. The data elicit and help to construct the frame; the frame defines, connects, and

filters the data." Hence, it invokes the processes in "an opportunistic mix" as identified by Pirolli and Card (2006) and has striking similarities with the processes described by Kent (1949) and Platt (1957). Sensemaking provides an emergent foundation for a scientific basis for what was perhaps intuitively sensed and captured by Kent and Platt.

In contrast with the early models of Kent and Platt that emphasized more extensive problem exploration and information acquisition or research prior to deliberate hypotheses generation, Heuer elaborated a different version of the analysis process in 1980 (Heuer 1981, pp. 66-67). He proposed an eight step model of "an ideal" analytic process, emphasizing *early deliberate generation of hypotheses prior to information acquisition:*

1. Definition of the analytical problem

2. Preliminary hypotheses generation

3. Selective data acquisition

4. Refinement of the hypotheses and additional data collection

5. Data intervention and evaluation

6. Hypotheses selection

7. Continued monitoring

In the late 1980s, the process described by Heuer started to be reported by others. For example, (1) the analysis process as "…a process of forming hypotheses, testing them with data, and integrating these findings into explanations, assessments, or predictions." (Berkowitz &

Goodman 1989, p. 85), and (2) hypothesis generation as the first step of the analysis process, followed by gathering and listing evidence and other steps (United States 1989, pp. 106-116). Heuer's 1980s description of the process continues to be a view of the analysis process as manifested by the following 2002 Joint Military Intelligence College (JMIC) chart (Figure 2) (Waltz 2003, p. 8).

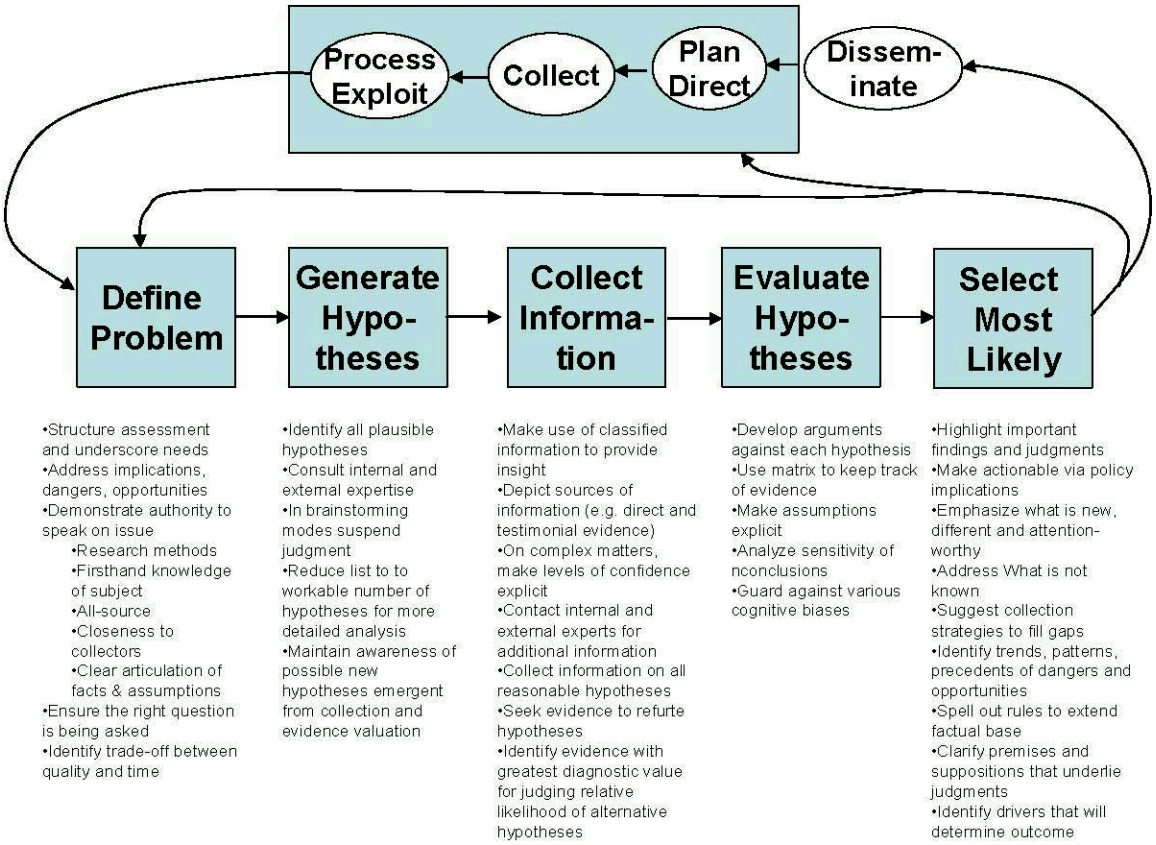

Figure 2. JMIC Intelligence Analysis Process Model

Comparison of Analysis Processes

Based on the preceding, the intelligence literature predominantly contains two different interpretations of the analysis process, which exist concurrently in the literature. Both views agree on the need to generate multiple hypotheses that must be subjected to verification or

rejection, but *they differ on the activities that should ideally precede the deliberate generation of hypotheses and the information used to generate hypotheses,* thus having implications for the amount and scope of information acquired that will serve as potential evidence. These two approaches have been characterized as *bottom-up or evidence-based* versus *top-down or hypotheses-driven.* Differences on the use of a bottom-up or a top-down process are not unique to the intelligence literature. In the scientific literature, arguments date back to Descartes (1596-1650) and Newton (1642-1727), as have those on the terms "analysis" and "synthesis" (Schum 2006, pp. 43-47). Schum (2006, pp. 44) points out "there is considerable confusion regarding the use of the terms analysis and synthesis in connection with discovery-related activities."

While there are general definitions of bottom-up and top-down processes, in the intelligence literature the two processes are described most explicitly by Schum (1987, p. 52) as *inference processes.* A "bottom-up" or "data-driven" inference is one "…in which reasoning proceeds from observable evidence to possible conclusions." A "top-down" or "hypotheses-driven" inference process is one "…in which a possible conclusion allows us to generate a chain or hierarchy of events leading to one or more potentially observable events whose occurrence or nonoccurrence would be evidence bearing upon our possible conclusion."

Overall, there has been little written on the relative merits of either approach. Cooper (Bodnar 2003, p. ix) comments favorably that Bodnar recognizes the limitations of the *bottom-up or evidence-based* approach: "It is gratifying that he also appreciates how limited the evidence-driven "connect the dots" model is in its applicability and that employing other models that rely more on hypothesis generation and testing are essential. Moreover, although Bodnar lives within an 'evidence-based culture,' he stresses the need to provide context as the only way to ensure

that the evidence can be interpreted correctly; 'the facts' don't speak for themselves." Cooper (2005, p. 5) later reinforces this view characterizing an evidence-based approach as an "…'Industrial Age' intelligence production model."

In contrast, Ryan (2006, p. 287) is quite critical of the *top-down or hypotheses-driven* approach citing several examples of faulty analysis resulting from its use, including the 2002 National Intelligence Estimate on Iraqi weapons of mass destruction. She states, "Rather than constructing a 'fact-based hypothesis', the Pentagon's Office of Special Plans (OSP), followed to a significant degree by the CIA particularly in the pivotal National Intelligence Estimate (NIE) of October 2002, designed an (sic) 'hypothesis-based analysis', which started with a preferred scenario and then found data that might support that. In effect, it was a worst-case scenario presented as a probability." Ryan (2006, p. 309) also states that "Such serious credibility issues might be lessened by avoiding hypothesis-based analysis which lends itself well to extreme politicization of intelligence."

The recent discourse about sensemaking explicitly elaborates the two predominant views of the analysis process, bottom-up and top-down. The iterative loops in the sensemaking model (Figure 1), as well as Klein's (2007) data-frame theory, are reminiscent of Kent and Platt. As Fishbein and Treverton (2004, pp. viii-ix) describe "Sense-making is a continuous, iterative, largely intuitive effort to paint a picture…" to cope with "…high levels of complexity and uncertainty." Klein et al. (2007, p. 114) point out that "Practitioners in real-world domains must confront and understand complex, dynamic, evolving situations that are rich with various meanings…there is nothing like an 'endpoint' since the understanding of dynamic events requires that the understanding itself be dynamic, not a stored, frozen 'meaning'." Yet from a classical scientific viewpoint there is discomfort with the intuitive aspects of sensemaking as

Klein (2004, p. hiv) alludes to in an earlier work. Collier (2005, pp.18-19) describes intuition with its "implicit connection of facts" as a "lower order" origin of knowledge (in his terminology, level 4 of 7), with science being the highest order.

The processes most frequently used by analysts are unknown. While Pirolli and Card's (2006) preliminary cognitive task analyses indicated both are used opportunistically, in his classic work Heuer (1999, p. 95) asserts "The way most analysts go about their business is to pick out what they suspect intuitively is the most likely answer, then look for the available information from the viewpoint of whether or not it supports this answer." Research is needed to better understand the processes used by analysts in their natural work environments and to understand the implications of various processes on the determination of meaning.

Hypotheses

Definitions of Hypotheses

As described previously, two processes concurrently exist in the intelligence literature leading to the generation of hypotheses. The process favored determines both the *timing* of deliberate hypotheses generation and the *character* of the hypotheses generated. That is, not only are two paths evident, but the character of the hypotheses generated is different.

Overall there is agreement on the definition cited by McDowell (1998, p.94) from the Concise Oxford Dictionary: "(1) a supposition made as the basis for reasoning, without assumption of its truth, or (2) a supposition used as a starting point for further investigation from known facts."

Specific definitions used in the intelligence literature include "…hypothesis in its broadest sense as a potential explanation or conclusion that is to be tested by collecting and presenting evidence." (Heuer 1999, p. 32); and "…a conclusion or assumption you may reach

about anything at all…a plausible explanation." (McDowell 1998, p. 93) Kent's (1967, p. 35) view of hypotheses is even more expansive, "Every time the mind perceives a relationship between two things it creates a hypothesis."

In the intelligence literature, the first dictionary definition is most often associated with the bottom-up or evidence-based process since the hypotheses are not used as the starting point but to reason about the acquired evidence. The second dictionary definition above is most often associated with the formation of hypotheses that represent potential answers or solutions to the intelligence problem, using a top-down, hypotheses-based approach. As stated by Heuer (2005, p. 91) "…analysts generally start by identifying what appears to be the most likely hypothesis--that is, the tentative estimate, explanation, or description of the situation that appears most likely."

Schum (1987, p. 29) provides the most detailed overall treatment of hypotheses at each step in the analysis process in his discussion of evidence and inference. His principle message is that marshalling evidence in support of the identified hypotheses results in a hierarchical inference network. At the top of the network will be the "major" or "ultimate" hypotheses, with various levels of "indicators or intermediate hypotheses" identified which have some bearing on the major hypotheses. "By such a process you are essentially determining categories of potentially-relevant evidence." This forms the hierarchical structure for the inference problem, with intermediate hypotheses at each level supporting the major hypotheses at the top of the network.

Hypotheses Generation and Multiple Hypotheses

Generating hypotheses is frequently discussed in the intelligence literature. Heuer has provided the most thorough treatment of the process. Acknowledging that his list is not exhaustive, Heuer

(1999, p. 32) provides three strategies for generating hypotheses, indicating "No one strategy is necessarily better than the others." His strategies are "Situational Logic," "Applying Theory," and "Comparison with Historical Situations."

Situational Logic is described as "…the most common operating mode…Generation and analysis of hypotheses start with…concrete elements of the current situation...the analyst seeks to identify the logical antecedents or consequences of this situation. A scenario is developed that hangs together as a plausible narrative. The analyst may work backwards to explain the origins or causes of the current situation or forward to estimate the future outcome." (Heuer 1999, p. 32-33) In *Applying Theory* a "…generalization based on the study of many examples of some phenomenon…" is used, and "…conclusions are judged to follow from a set of conditions and a finding that these conditions apply in the specific case being analyzed." (Heuer 1999, p. 34-35) When using *Comparison with Historical Situations* "An analyst seeks understanding of current events by comparing them with historical precedents in the same country, or with similar events in other countries…analysts use their understanding of the historical precedent to fill gaps in their understanding…" (Heuer 1999, p. 38)

Heuer (1999, pp. 40-41) discusses a fourth strategy called *"Data Immersion,"* which he rejects for the same reason as the jigsaw puzzle analogy: the assumption that a mental model is not used and this is not possible for analysts to do. According to Heuer, this approach is described as analysts "…immersing themselves in the data without fitting the data into any preconceived pattern." Heuer's description of the immersion process is different than the description used in the qualitative research literature (Borkan 1999). While both descriptions include an intense concentration on the data, the qualitative research description emphasizes the role of the person engaged in the process and that success is dependent on the full involvement

of the individual. As described in the qualitative research literature, data immersion appears to be a promising strategy for generating hypotheses and applied research in intelligence analysis is needed.

Heuer (1999, p. 95-107) has also written the most extensively on a technique he developed, Analysis of Competing Hypothesis (ACH), to counteract analysts' tendencies to intuitively select what they consider to be the most likely answer and look at whether the available information supports the selected answer. The technique entails identifying possible hypotheses by brainstorming, listing evidence for and against each, analyzing the evidence and then refining hypotheses, trying to disprove hypotheses, analyzing the sensitivity of critical evidence, reporting conclusions with the relative likelihood of all hypotheses, and identifying milestones that indicate events are taking an unexpected course.

The use of brainstorming in ACH is a key feature, because in a top-down or hypotheses-driven process, *the quality of the hypotheses is dependent on the existing knowledge and experience of the analysts,* since hypotheses generation occurs before additional information acquisition augments the existing knowledge of the problem. Increasing the number of hypotheses generated is consistent with Kent's view (1949, p. 174) that "What is desired in the way of hypotheses, whenever they may occur, is quantity and quality." However, in contrast to Heuer, *Kent emphasizes extensive information acquisition based on understanding the problem (purpose) before the deliberate generation of hypotheses.* He states, "…two things an intelligence organization must have in order to generate more and better hypotheses: (1) professional staff of the highest competence and devotion to the task, and (2) access to all relevant data."

ACH is widely cited in the intelligence literature as a positive method for improving analysis. Heuer (1999, p. 109) describes the advantages of ACH, including that many potential answers (hypotheses) to the intelligence problem are considered and subjected to a consistent approach for rejection or validation. He implies using ACH will mitigate confirmation bias in intelligence analysts since many hypotheses are considered, but this has not been substantiated by research (Cheikes et al. 2004, p. 1 & p. 16).

In contrast, Klein et al. (2007, p. 146) reference a study by Rudolph (2003) on medical practitioners showing extensive hypothesis generation was "…almost as dysfunctional as fixation" on a given hypothesis. The data-frame theory (Klein et al. 2007) referenced earlier "…regards early commitment to a hypothesis as inevitable and advantageous," permitting "…efficient information gathering and more specific expectancies that can be violated by anomalies, permitting adjustment and reframing." Klein ('Improving Intelligence Analysis' 2007, p. 46) also characterized keeping an open mind and avoiding premature consideration of a hypothesis as "…one of the classic mistaken beliefs about analysis." The central message is not to keep an open mind or avoid having hypotheses, since this is not possible due to the nature of mental models, but to keep testing one's hypotheses and judgments.

Intelligence Research

The analysis processes described (bottom-up, top-down, and sensemaking) all require the acquisition of facts, data, and information (the name used to describe the input to intelligence analysis continues to evolve). Generally this acquisition phase is called intelligence research, although some have used the term to describe the entire analysis process (Clauser & Weir 1976).

Although Kent (1949) does not provide a description of research in his classic work on intelligence, he does in *Writing History* (Kent 1967). The essence of the Kent's research method

is to find all that one can about the topic being researched (Kent 1967, p. 25) and to develop comprehensive knowledge of all the applicable sources (Kent 1967, p. 25-34). Drell (1957) later provides a more detailed description of intelligence research consistent with Kent's.

The search of information in the bottom-up approach is *problem-based, guided by one's understanding of the problem* under study (Kent 1949, p. 157; Valtorta et al. 2005, p. 1). In the top-down approach, the *tentative hypotheses are used as the conceptual framework for selecting information* (Heuer 2005, p. 91; United States, pp. 106-107). Schum (1987, p. 16) is more explicit about the role of hypotheses: "Having expectations, in the form of initial or preliminary hypotheses, is commonly recognized as a necessary prerequisite for efficient and productive data search." Schum is likely correct that searching for information relating to a set of hypotheses requires less time and effort than searching for all information relevant to the entire scope of the problem under analysis. However, thorough problem exploration and purpose refinement followed by information acquisition based on the problem will likely result in more complete acquisition of all the relevant evidence. This has significant implications for the conduct of the intelligence process; research is needed to fully understand these implications.

Since Drell's (1957) treatment of intelligence research, the topic has received very little attention. This lack of attention, coupled with similarly large gaps in the intelligence literature on the topics of information relevance and retrieval, constitutes a major omission in the literature, given the role and importance of information in the analysis process. Research is needed to address these gaps.

Some have ascribed the lack of treatment of intelligence research to the shift in emphasis from long-term analysis to current intelligence (AFCEA 2005, p. 6) Kent (1949, p. 196) warned of the diversion of effort from long-term analysis to more current tasks and the compelling

tendency to put analysts on this kind of work. He does not argue that it is unimportant, but that it absorbs too much talent. He emphasizes, "Intelligence should have long stretches of uninterrupted time to carry out long-range project which can be done in no other circumstances." (Kent 1949, pp. 196-197)

When Hilsman (1981) surveyed policymakers (c. 1956) about their needs for intelligence, he found a strong preference for current intelligence versus long-term study. Hilsman was most surprised that much of the pressure for current intelligence arose from intelligence personnel. Subsequently many authors, with increasing frequency, have lamented about the emphasis on current intelligence and the ramifications of this shift on long-term analysis. The concern is captured in the following (Risen 2006, p. 7):

> "'If I had to point to one specific problem that explains why we are doing such a bad job on intelligence, it is this almost single-minded focus on current reporting,' observes Carl Ford, a former CIA analyst and former chief of the Bureau of Intelligence and Research at the State Department. In the 1970s, Ford adds, 70 percent to 80 percent of CIA analysts spent their time doing basic research on key topics; today, about 90 percent of analysts do nothing but current reporting. 'Analysts today are looking at intelligence coming in and then writing what they think about it, but they have no depth of knowledge to determine whether the current intelligence is correct. There are very few people left in the intelligence community who even remember how to do basic research.'"

Marshalling of Evidence

After information is acquired, cognitive processes are used to extract evidence from the information, to interrelate evidence and evaluate various hypotheses, and ultimately select a hypothesis or hypotheses (depending on the nature of the problem under study) with associated

likelihoods. Despite the crucial nature of these actions, the intelligence literature is silent on how to do this part of the process, with one notable exception, the work of David A. Schum and his colleagues. They treat the complete spectrum of constructing inference chains and their ingredients, judging credibility, marshalling of evidence and drawing conclusions (Schum 1987; Schum 1999; Schum 2001; Anderson et al. 2005). Schum addresses the many subtleties of drawing conclusions from massive amounts of evidence, including the role of hypotheses, categorizing evidence, hierarchical inference, source credibility, and assessing inferential weight using Bayes' Rule and other less commonly referenced approaches to probability (e.g., Shafer's belief functions and Baconian probability). Given that determining the meaning of information is the core of analysis, Schum's work (1987) is a classic, foundational reference work, with day-to-day relevance.

From the wide range of topics that Schum deals with, three are especially relevant for providing insight to the intelligence literature: hierarchical inference, ancillary evidence, and assumptions.

The concept of hierarchical inference is based on the idea that inferences from evidence are a necessary input to draw inferences from another piece of evidence. As Schum (1987, p. 52) points out, these inferences can be established in either a bottom-up or a top-down approach. Drawing inferences from *each item of evidence* is inherent in both bottom-up and top-down approaches, and these inferences are then used as an input to drawing inferences from other items of evidence. A comparable approach, albeit expressed differently, has been suggested by Connell (Connell 2007, p. 13). He proposes that "Instead of trying to produce several alternative explanations accounting for multiple data items simultaneously…, the analyst could focus on a single datum at a time and brainstorm its implications for just one aspect of an explanation…"

This approach seems to be conceptually different than the treatment of evidence described in the ACH method.

Schum (1987, p. 93) defines ancillary evidence as "evidence about evidence" that has an indirect relevancy to a major conclusion. Acquiring ancillary evidence requires different strategies. Information that will serve as ancillary evidence is not likely to result from either a problem-based information acquisition strategy or one based on a set of hypotheses. Specific consideration must be given to how to derive that ancillary evidence and then acquire it. For example, one must first identify potential direct evidence. Based on that potential direct evidence, one must then derive what elements of information potentially could serve as ancillary evidence to provide insight on matters where perhaps the direct evidence is not available. Specific approaches for the process of then acquiring such ancillary evidence are not discussed in the intelligence literature. Research and resulting guidance for analysts on how to derive and acquire ancillary evidence is needed.

While there is much discussion in the intelligence literature about the importance of identifying assumptions, no other works address both the scope of what should be considered as assumptions and offer the depth of treatment that Schum does. He describes assumptions as the essential "glue" holding arguments and the supporting inference networks together (Schum 1987, p. 35) Schum (1987, p. 17) also points out that differences in judgments regarding the meaning of information are usually due to the existence of different assumptions. Anderson et al. (2005, p. 266-276) provide a comprehensive explanation of the wide range of beliefs that should be considered as assumptions, ranging from our personal "stock of knowledge" or "common sense" through scientific knowledge that varies in terms of reliability. Muller (2008, p. 2) provides illustration of this in his discussion of how "…a person's underlying set of beliefs, assumptions,

experiences–even wisdom–about how the world works" affect judgments made by that person. Muller uses the Red-Blue political dichotomy based on graphics used in the 2000 presidential election to portray how worldviews affect intelligence analysis. A similar view has also been expressed regarding why people disagree so stridently about foreign policy (Nau 2007).

Statements are widespread regarding the necessity of explicitly identifying the assumptions used in the analysis. These discussions do not focus on the wide range of assumptions that are fundamental to how analysts determine meaning. Consequently, a reason for the apparent failure of the analysts to comply with these directions can be inferred from the discussion of Red-Blue analysts (Muller 2008), as well as the wide range of assumptions identified by Anderson et al. (2005). That is, *analysts are unlikely to equate their beliefs to assumptions* (Muller 2008). A comprehensive, in-depth understanding of all the elements discussed in Schum's treatment of inference and evidence is essential to promoting rigor in intelligence analysis and improving the determination of meaning.

Rigor

Since September 11, 2001 and the numerous studies of the failure and resulting intelligence reform, the importance of rigorous analytic thinking has been emphasized. While there is much in the intelligence literature about rigor, there are few specifics on how to improve it throughout the analytic process. Zelik et al. (2007) have conducted research to refine the understanding of rigor in intelligence analysis. They point out that generic definitions of rigor often focus only on rigid and meticulous adherence to processes with precise and exacting standards. Their research indicates that expert information analysis is often not rigid, but flexible and adaptive to highly dynamic environments and judgments about rigor must reflect the appropriateness of fit between analytic processes and contextual requirements. Consequently, "…rigor is more meaningfully

viewed as an assessment of degree of sufficiency, rather than degree of adherence to an established analytic procedure." (Zelik et al. 2007, p. 1) Based on their research and findings from other studies of professional intelligence analysts, they have identified eight critical attributes of analysis processes that contribute to assessments of rigor (Zelik et al. 2007, p4). With the exception of addressing the problem definition and exploration steps, these attributes encompass the analysis process steps identified by Kent, Platt, and Heuer. Zelik et al. have also identified attributes focused on incorporating perspectives of other domain experts, which are not explicit steps in the Kent, Platt, and Heuer processes.

Structured analytic techniques and automated aids and tools have much to offer relative to the attributes of rigor identified by Zelik et al. (2007). Potential contributions include systematic approaches for verifying information, identifying the source's perspective when evaluating data, considering and understanding assumptions and limitations of analysis, extracting and integrating diverse interpretations of information, examining the chain of reasoning, explicitly identifying stronger and weaker inferences, and exploring and weighing alternatives. At the root of such techniques is the use of probabilities and belief functions to quantify uncertainty; explore alternatives; evaluate the completeness of evidence; and assess relative likelihoods, risks, and ambiguities associated with specific states. These techniques can also provide the advantage of an observable trail of judgments that can be used as the basis for assessing rigor.

Automated tools have been and continue to be developed with the objective of improving analysis and supporting the analytic process, including increasing rigor, dealing with uncertainty, and alleviating aspects of analysts' workload (e.g., data overload). A considerable amount of literature on these tool developments exists and, generally, most tool developments are in two

broad categories: (1) data acquisition and retrieval, and (2) hypothesis generation and evaluation. To date, very few developments have attempted to address the continuous evolution of purpose, context, and the analyst's knowledge--all key factors dynamically shaping the mental model--into processing information and the conduct of the intelligence process in its entirety.

Recently new approaches have emerged, based on sensemaking research, to develop automated work environments that consider and support the analysis process in a holistic way—as an end-to-end coherent whole instead of treating only specific elements of the process without the benefit of the context of the other interdependent elements (Hollywood et al. 2004; Eggleston et al. 2005; Pioch & Everett 2006) The holistic approach of these developments is in contrast to the myriad of prior and ongoing developments that focus on supporting only a specific element of the analysis process (e.g., data mining, visualization, Bayesian belief networks, social networks, ACH, inference networks).

As Zlotnick stated (1972, p. 42), "The very best that intelligence can do is make the most of the evidence without making more of the evidence than it deserves." Automated work support aids, tools, and structured analytic techniques provide a variety of means to increase overall rigor in the identification and treatment of evidence, thereby improving the determination of meaning throughout the entire analysis process. If chosen appropriately considering the holistic nature of the intelligence issue under study, they can contribute rigor even though pure, sterile objectivity is unobtainable due to the nature of determining meaning. While rigor is often mentioned in the literature and specific tools and techniques received a great deal of attention, the literature and the practice of analysis would be enriched by additional research on understanding the various attributes of rigor in intelligence analysis. In addition, research is needed on implementing methods for assessing those attributes in actual intelligence work environments, as well as on the

development and use of holistic automated work environments that incorporate the strengths of the various processes and approaches in the intelligence literature to attain such rigor.

Observations

Because the world has changed a great deal since the classic writings of intelligence analysis, some may be tempted to dismiss them out of hand as irrelevant or outdated. Yet all well established professions (e.g., law) have an established, foundational literature sometimes centuries old which endures. Those professions well advanced in terms of their development also have literatures which have expanded the foundation well beyond the initial principles to deal with the full complexities of the core aspects of the profession.

While much as been written about intelligence since the 1940s and 1950s, and there has been much written on various activities that intelligence analysts must do, the literature has not advanced on the core aspect of determining meaning from information to address the full range of complexities in intelligence analysis. After the initial classic works, the discourse on this has largely disappeared. That is not to say that there have not been new ideas put forth relative to how to better deal with certain individual components of the work (e.g., special techniques, technologies to manipulate more information, etc.). Yet, a comprehensive approach to move forward and tackle the complexities of the work has not fully emerged.

In some respects intelligence analysis has been addressed in a way consistent with the standard definition of analysis, breaking up of the whole into parts, rather than a focus on the synthesis of the profession "as to form a whole." In a few cases, works such as those on sensemaking have "re-introduced" the notion of addressing the core of the phenomena of intelligence analysis, its very essence, to advance the practice of intelligence analysis and its

ability to deal with the aspects of complexity, uncertainty, and dynamic environments that traditional scientific methods have not been able to fully address.

While no single approach, over time, fully dominates the other, embedded in the literature are the strengths of the various approaches. Key elements are a holistic framing and exploration of the problem (as indicated early on by Kent and Platt), systematic data collection relative to the problem and purpose, rigorous treatment of the data and evidence, generating hypotheses based on knowledge, and repeated testing and retesting of one's hypotheses.

Since the beginning of modern intelligence analysis, there have been concerns about the pressures of time, the experience level of analysts, and relevance to customers. There ultimately are no cognitive shortcuts to using the best of the classic approaches. The price of doing so will always be paid later, if not now. Tools and resources can provide essential support to facilitate thinking and reduce cognitive burden, as can constructive, enabling management and organizational practices. Imperative, though, is the need for a concerted focus on the core aspect of analysis: how do analysts determine meaning and what can aid them in doing so. While times and context change and the peripheral issues are adjusted, as with more established professions (medicine, law, etc), the phenomena of analysis maintains a stability at the core. The challenge for intelligence studies on analysis is to focus on the core aspect of analysis, determining meaning, in a holistic way to address gaps in understanding and in the literature, providing the foundation to implement in practice.

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